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IV. 7. Prototype of High Resolution PET Using Resistive Electrode Position Sensitive CdTe Detectors

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We developed a prototype of high resolution PET using position sensitive CdTe detectors. A resistive electrode is needed for a position sensitive detector. We developed a method to make a resistive electrode on a CdTe crystal and made one dimensional position sensitive CdTe detectors experimentally. The position resolution of 1.2 mm (FWHM) was obtained. We constructed a prototype of PET using position sensitive CdTe detectors, which has a high resolution of ~ 1 mm (FWHM).

Resistive electrode on CdTe crystal

Performance of semiconductor detectors depends on electrode structures. The Schottky type CdTe detector whose electrode structure is In(anode)/CdTe/Pt(Cathode) has a good reverse bias performance. Hence, a high bias voltage (several hundred V/mm) can be applied to the detector and a good time resolution can be obtained compared with other CdTe detectors. So, position sensitive and Schottky type detectors are suitable for PET.

Supposed that the resistivity of the electrode depends on its thickness, we obtained a relation between the thickness and resistance.

Figure 1 shows a relation between In electrode thickness and resistance. The resistance is inversely proportional to the electrode thickness. So, the resistivity of In electrode can be increased by thinning the electrode thickness. This results that the Schottky type detector with high resistive electrode can be made.

One-Dimensional position sensitive CdTe detector (1D-PSD)

Figure 2 shows a photo and a schematic image of a 1D-PSD made experimentally

with a 20 × 10 × 1.0t mm^3 crystal. The In electrode thickness is 750 Å, and the resistance is about 150 kΩ. Two signals from a anode are denoted by signal 1 and signal 2 and that of a cathode by signal 3.

We measured a position resolution of the detector using β rays from a collimated Am source. The surface of the detector was irradiated withβ rays. Figure 3 shows position spectra of the signal 1 / the signal 3. A good position resolution of about 1.2 mm (FWHM) at the center of the detector was obtained.

Prototype of PET using position sensitive CdTe detectors

We constructed a prototype of PET using position sensitive detectors. The prototype consists of 2 detector units which includes 16 1D-PSDs and a preamplifier circuit respectively (Fig. 4 (right)). A ^{22}Na point source (active area: about 0.5 mm diameter) was placed on a rotating stage. The reconstructed images of the point source and their profiles are shown in Fig. 5 (transaxial) and Fig. 6 (axial). The transaxial spatial resolution of 0.75 mm (FWHM) and the axial one of 1.5 mm (FWHM) were obtained.

The axial resolution (1.5 mm) is larger than the position resolution of PSD (1.2 mm). This result is due to the thickness of CdTe detectors (1 cm) and can be improved by using DOI information. Development of two dimensional position sensitive detectors is in progress in our laboratory.

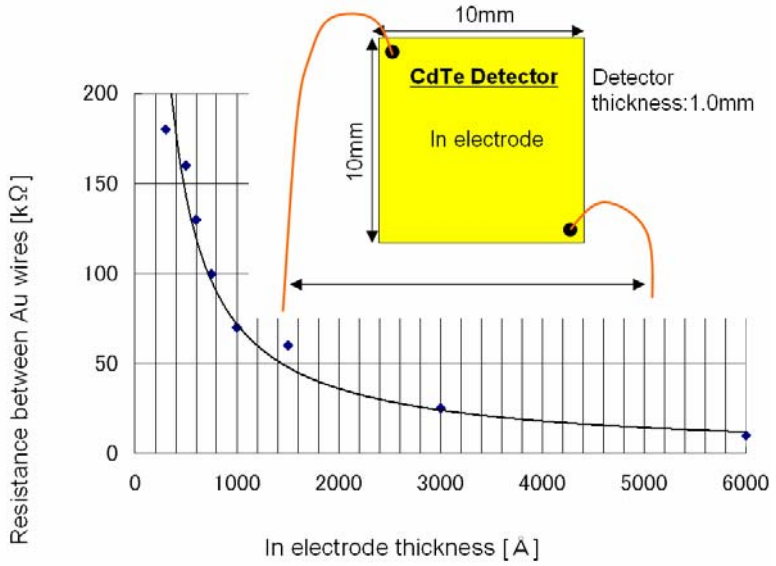

Figure 1. Resistance of In electrode as a function of its thickness.

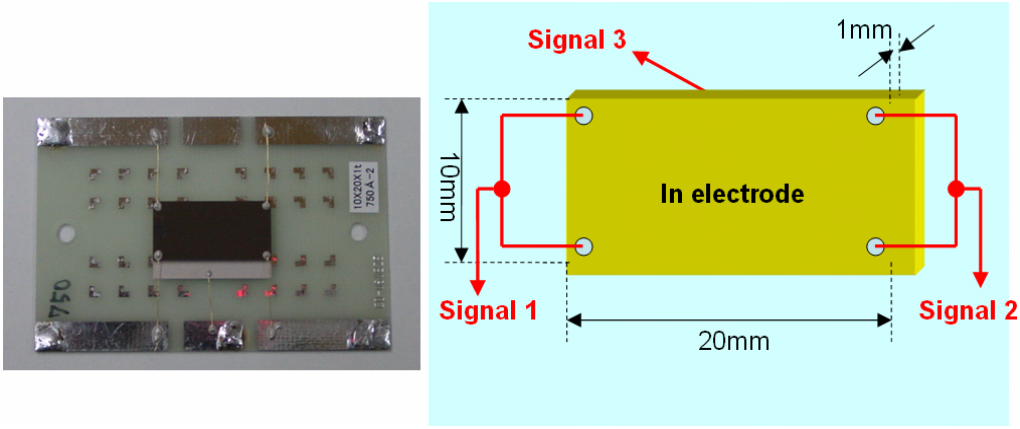

Figure 2. Photo and schematic image of 1D-PSD.

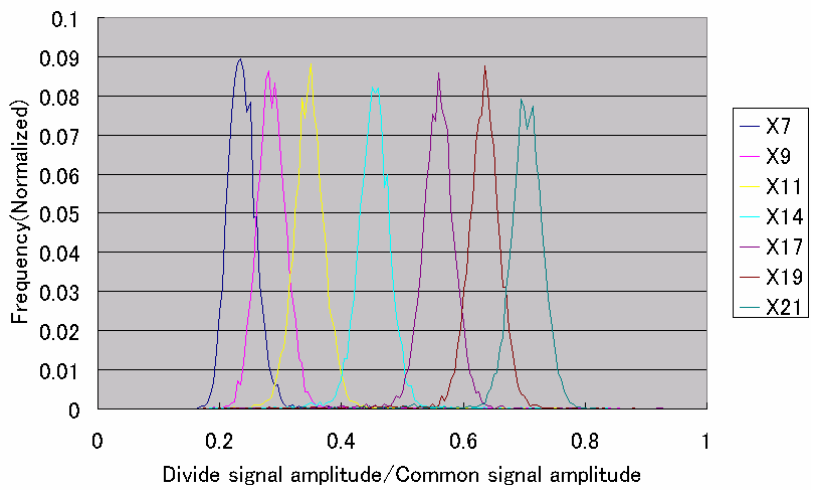

Figure 3. Position profiles of 1D-PSD.

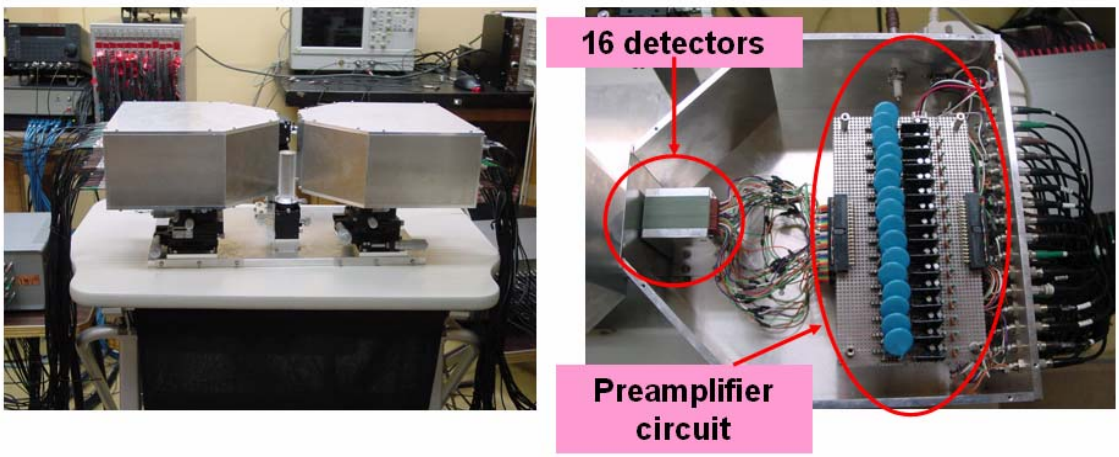

Figure 4. Detector units (left) and the inside of the unit (right).

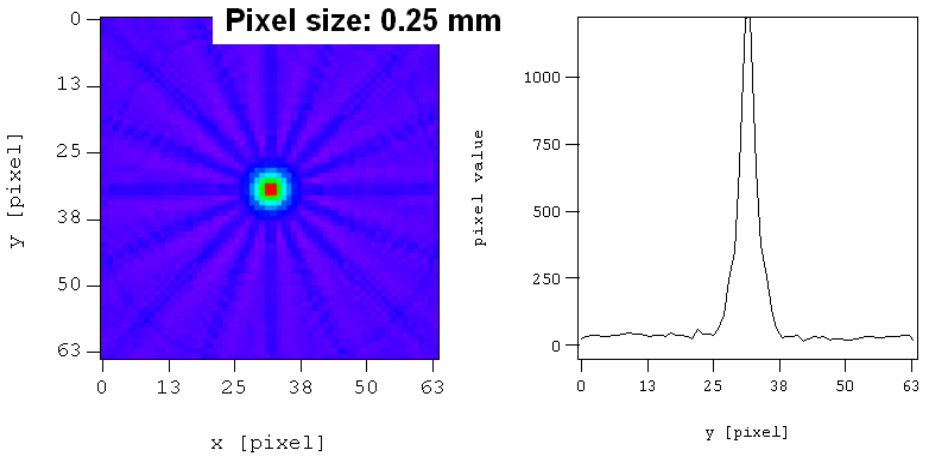

Figure 5. Reconstructed image and profile (transaxial).

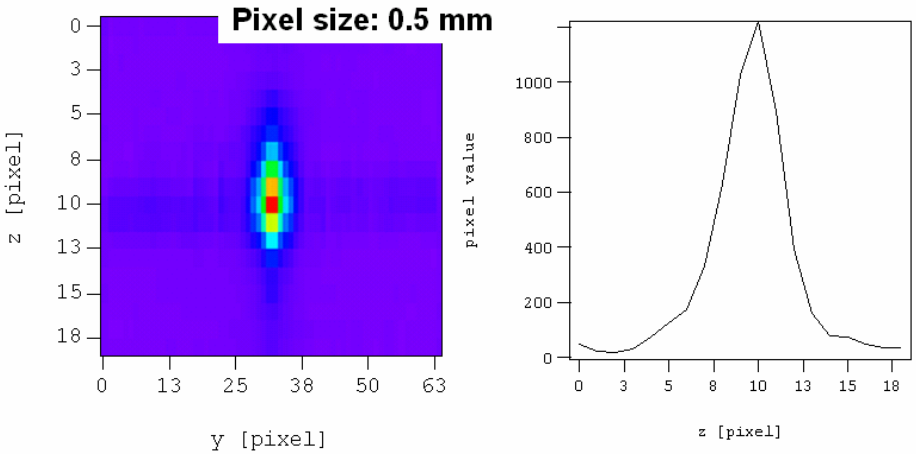

Figure 6. Reconstructed image and profile (axial).